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ABSTRACT

The effects of two interdependent group contingencies, group-average and group-individual, on math performance and verbal interaction were investigated. In a group-average contingency the average performance of the members of the group must meet a set criterion level. In a group-individual contingency each member of the group must meet a set criterion level. Five neurologically impaired students were used as subjects. A three-phase experimental design was used. The effect of the contingencies on math performance was found to be ambiguous. The data on verbal behavior indicate that the contingencies had a definite effect on the neutral, positive, and negative verbalizations emitted by the subjects. (Author)

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The Effects of Two Interdependent Group Contingencies on Peer Verbal Interaction and Math Performance

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The Effects of Two Interdependent Group Contingencies on Peer Verbal Interaction and Math Performance

The development of behavioral technology, specifically behavior modification techniques has produced a plethora of research. The major objective of this research has been to explore and discover the range of application of the technology. In most studies, the research is designed to investigate the "intended" effects of a procedural intervention. It has become increasingly apparent that no matter how well designed, a technological intervention (especially when human subjects are involved) does not produce only a single effect but may bring about "unintended" or "side effects" with which researchers must contend (Willems, 1974, pp. 155-156, Rogers-Warren and Warren, 1977). Behavioral researchers are obligated to determine the side effects of contingencies on behavior. The reason for the necessity to understand side effects has been logically presented by Willems (1974). He points out that there is a fundamental misconception in the term side effects. Effects which are labeled side effects, "no more deserve the adjective 'side' than does the 'principal' effect - they are all aspects of the interdependencies that we need so badly to understand" (p. 155). All too often behavioral researchers enter a classroom, change specific behaviors by manipulating contingencies and leave believing they have helped the subject(s). All this takes place without an investigation of how the change in the

specific behavior(s) has affected the subject's total behavior repertoire and/or pattern of social interaction. In other words little thought is given to how the specific change affects the subject's behavior in general.

Group contingency, perhaps more than others, have the potential to affect the general behavior and interaction patterns of the subject(s) involved. This is due to the influence of peer interaction on behavior during group contingencies. Behavioral research has demonstrated the effectiveness of group contingencies in modifying both academic behaviors (Bushell, Wrobel, and Michaelis, 1968; Sloggett, 1971; Wilson and Williams, 1973) and social behaviors (Axelrod, 1973; Herman and Tramontana, 1971; Long and Williams, 1973). The majority of studies of group contingencies have been primarily concerned with investigating the effects of these contingencies on the usual target behaviors of increased response rate and accuracy or talking out and out of seat behaviors.

Other studies indicate that peers do exert some control over the behavior of the members of their group. Wahler (1967) concluded that preschool children's behavior in free field settings is subject to the control of their peers. It has also been shown that peers can change behavior through the direct control of consequences. Peer reinforcement of appropriate social behavior and peer ignoring of inappropriate social behavior produced less inappropriate social behavior in a study conducted by Solomon and Wahler (1973). Strain and Timm (1974) and Strain (Note 2) found that the manipulation of contingencies of positive peer

control with predetermined target subjects increased both positive interaction of peers toward target subjects and target subjects toward peers.

Although most group contingency studies have not been concerned with side effects some have reported, anecdotally, that side effects are generated by group contingencies. Sloggett (1971) has reported that a group contingency not only resulted in an increase in academic productivity but also resulted in an increase in peer pressure. Andrews and Williams (1970) analyzed peer verbal interaction under a group contingency and found it produced an increase in peer attention to non-task behavior. It was not reported whether the attention was positive or negative. It has also been found that a group contingency increased both positive and negative on-task verbal interaction but did not affect off-task verbal interaction (Shores and Norman, Note 3). In a study which investigated the effect of a group contingency on individual misbehavior Greene and Pratt (1972) reported that threats were made to misbehaving individuals by other students. The results of these studies clearly indicate that group contingencies produce effects other than those intended.

The major purpose of this study was to determine the effects of two interdependent group contingencies, group-average and group-individual on peer verbal interaction when math performance is the targeted behavior. In a group average contingency the average performance of the members of the group must meet a set criterion level. In a group-individual contingency each member of the group must meet a set criterion level. These contingencies

are considered interdependent because the same response contingencies are in effect for all group members and are applied to a level of group performance (Litow and Pumroy, 1975, p. 343).

Method

Subject and Settings

The subjects for this experiment were five neurologically impaired students, three girls and two boys. They ranged in age from 10 years to 10 years 9 months. Their reading and math grade levels, as measured on the Peabody Individual Achievement Test, ranged from 2.0 to 3.4 for reading and 2.0 to 2.3 for math. (This information was not available for one subject.) The subjects were chosen by the classroom teacher because they functioned at approximately the same math level.

The study was carried out in a self-contained classroom for neurologically impaired children. The school is located in a suburban Philadelphia community.

Target Behaviors

Verbal Interaction. Verbal interaction has been divided into three categories: verbal negative, verbal positive, and verbal neutral, with the following definitions:

Verbal Negative: Any verbalization which connotes a negative meaning related to the academic task, another child in the group, the group as a whole, the teacher, or the child uttering the verbalization (e.g. I

don't like you, you're not working fast enough, hurry up, you're dumb, you're making us lose, this work is stupid, etc.).

Verbal Positive: Any verbalization which connotes a positive meaning that is related to the academic task, the group as a whole, the teacher, another child in the group or the child uttering the verbalization (e.g. you're working hard, you helped us win, good work, you're right, etc.).

Verbal Neutral: Any verbalization which cannot be scored as verbal positive or verbal negative except any verbalizations not directed to another person that pertains to the computation of the problem (e.g. counting out loud).

The term verbalizations in this case does not include vocalizations (e.g. noises, snorts, coughs, burps, etc.). A verbalization indicates the utterance of at least one understandable word.

Math Performance. Math performance was measured on individual and group accuracy. Individual accuracy was calculated by dividing the number of problems correct by the number attempted. A problem was considered attempted if at least one numeral had been placed in the answer.

At the beginning of the study all the children were solving additon problems with sums of 20 or less where no carrying was involved. During the course of the study the type of math skill or type of problem was adjusted to meet the instructional needs of each student at any point in time. This adjustment was left to the discretion of the classroom teacher (J. B.). In this way the study did not affect the attainment of new math skills by the subjects.

Observation and Reliability Procedures

Each session lasted fifteen minutes. The teacher reported all data using an interval recording system. Each session was divided into sixty fifteen second intervals. (See Appendix I for sample data sheet.) Each verbalization was recorded in the corresponding interval in which it began as, verbal positive, verbal negative, or verbal neutral. Each sentence was considered a discrete verbalization. The person to whom the verbalization was directed was also recorded by placing the initial of the person's first name in the corresponding interval. If it couldn't be determined to whom a verbalization was directed a G was recorded to indicate that the comment was directed to the group. If the subject directed the comment to him/herself an X was recorded. Any verbalization that could not be understood was not recorded.

Reliability checks for verbal interactions were made at least once for every five experimental sessions. One observer (D. W.) and the teacher (J. B.) were physically situated so that data recording was independent. Reliability for verbal interaction

was calculated by the following formula:

$$\frac{\text{No. Agreements}}{\text{No. Agreements} + \text{No. Disagreements}}$$

An average reliability of 94% was achieved with a range of 91% to 98% agreement. Reliability for math accuracy was conducted by having two of the authors (D. W. and J. B.) independently grade the students' papers. This was conducted at least once for every five days of the study. Reliability was calculated by dividing the smallest number scored correct or attempted by the highest number scored correct or attempted. An average reliability of 97% was achieved.

Experimental Procedures

A three phase experimental A, B, C design was used. Each phase was kept in effect until a stable rate of verbal interaction and math performance was obtained.

Phase A - Baseline. In this phase no contingencies were in effect. At the beginning of this phase students were told by the teacher, that they would be doing their math together as a group at a table in the back of the classroom. They were instructed that they could talk to each other if the desired. This phase lasted 14 days.

Phase B - Group-Average Contingency. In this phase the students were instructed that they had the opportunity to earn fifteen minutes of free time after the math period if the group got an average of 70% of their problems correct. If they did not reach this criterion they were told that they would have to return to their desks and begin their classwork. This phase lasted 11 days.

Phase C - Group-Individual Contingency. In this phase the students were instructed that each individual member of the group would have to get 70% of his/her problems correct for the whole group to earn the fifteen minutes of free time after the math period. They were also told that if any one person did not get 70% of his/her problems correct the whole group would have to return to their desks and begin their classwork. In this phase the students were told who did not meet the criterion if the free time was not earned. This phase lasted 6 days.

Results

The effect of the group contingencies on math performance was inconclusive. The effect on group math accuracy was minimal, while the effect on the individual subjects' math accuracy was very diverse.

The average group math accuracy for the baseline phase was 71% with a range of 50% to 93%. The math accuracy during the group-average phase was 71% with a range of 67% to 84%. The math accuracy during the group-individual phase was 82% with a range of 75% to 88%. When viewing the data in Figure 1 it can be seen that they are unstable across all phases.

Insert Figure 1 about here.

The individual subjects had differing responses to the group contingencies. The contingencies had a minimal effect on the math performance of subject A. The average math accuracy varied little across contingencies. It was 95% during baseline,

dropped to 88% during the group-average phase and increased to 93% during the group-individual phase. The average math accuracy of subject B dropped from 88% during baseline to 64% during the group-average phase. It increased to 77% during the group-individual phase. The data for subject C are unstable across all contingencies. The change from baseline to the group-average phase resulted in a slight drop in the average math accuracy from 58% to 50%. The institution of the group-individual phase had a strong effect. Math accuracy increased to 77% during this phase. The math accuracy for subject D increased from an average of 66% during baseline to 89% during the group-average phase. Math accuracy decreased to an average of 85% during the group-individual phase. For subject E the group-average phase had a minimal effect, with the average math accuracy increasing from 56% during baseline to 60%. The group-individual phase had a strong effect. Math accuracy increased from an average of 60% during the group-average phase to 81% during the group-individual phase. Figure 2 presents math performance data for each subject.

Insert Figure 2 about here.

The verbal behavior data, when plotted across the no-contingency, group-average, and group-individual phases, indicate that the contingencies had a definite effect on verbal behavior (See Figures 3, 4, and 5). The results show that neutral verbalizations remained low and stable across all phases when directed to the self. Neutrals directed to the group steadily increased

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Insert Figures 3, 4, and 5 about here.

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after an initial decrease at the on-set of the group-average contingency. Verbal neutrals directed to the teacher increased during the no-contingency phase, then steadily decreased across the group-average and group-individual phases.

No positive verbalizations were directed to the teacher during the course of study. Positive verbalizations directed to the self slowly increased during the no-contingency phase then decreased at the introduction of the group-average contingency and remained low during the group-individual contingency. Positive verbalizations directed to the group remained low during the no-contingency phase then increased across the group-average and group-individual contingencies.

No negative verbalizations were directed to the teacher in any experimental phases. Negative verbalizations directed to the self decreased during the group-average phase and no negatives were directed to the self during the group-individual phase. Negatives directed to the group increased slightly during the group-average phase, then sharply increased during the group-individual phase.

Discussion

As stated earlier, the effect of the group contingencies on math performance is ambiguous. This is primarily due to the variability of the data and a ceiling effect. The group math accuracy data are unstable across all phases. For the last five days of the no-contingency phase the group math accuracy ranged between 85% and 90% creating a ceiling effect. The decline in math accuracy at the beginning of the group-average phase may not be directly related to the change in contingencies. It may be due to the introduction of a new math skill for subjects A, B, and C on the first day that this contingency was in effect. The increase in the average group math accuracy from 71% in the group-average phase to 82% in the group-individual phase tends to indicate that the group-individual contingency did increase math performance. However, the data show that the group math accuracy was in a general upward trend in the group-average phase. The increase during the group-individual phase may have been a continuation of this trend. Again the variability of the data makes interpretation difficult.

The individual math accuracy data are also difficult to analyze. The data for subjects B, C, and E are very unstable. Subjects A, B, and D reached ceiling during the no-contingency phase making it impossible to determine the effect of the group contingencies. The decrease in average math accuracy in the group-average phase for subject B probably is due to the introduction of the new math skill at the beginning of this phase.

It can also be seen that math accuracy was in an upward trend during this phase. This is probably due to a practice effect. The increase in the average math accuracy during the group-individual phase for subjects C and E may indicate that this contingency did have a differential effect on the subjects' math performance. The lack of stability of the data make this conclusion tentative.

The effects of the contingencies on verbal behavior are more conclusive. The fact that there were few verbal neutrals directed to the self across contingencies is not unexpected. The steady decrease in neutral verbalizations directed to the teacher, and gradual increase of neutrals directed to the group during the group contingencies are interesting. These results indicate that when the contingencies were in effect it became less functional to talk to the teacher. It is very possible that talking to the teacher during the no-contingency phase was socially reinforcing to the subjects. When the contingencies were made effective, the opportunity to earn free time became more reinforcing than talking to the teacher. The increase of verbal neutrals directed to the group could possibly have been caused by the fact that the students were working together toward a common goal. However, there are no hard data to support this contention.

The low amount of verbal positives directed to the teacher throughout the experiment and directed to the group during the no-contingency phase is not unusual. The results show that the group contingencies caused a decrease in the verbal positives

directed to the self and an increase in verbal positives to the group. It is obvious that the group contingencies made it more functional to reinforce the group and its members than to reinforce the self. The data also indicate that the different types of group contingencies did not have a differential effect on the amount of verbal positives.

The effect of the group contingencies was generally the same on verbal negatives as verbal positives. No negative statements were made to the teacher during the experiment. The contingencies caused a decrease in verbal negatives to the self and an increase in negatives to the group. It is very important to note that the group contingencies had a differential effect on verbal negative benavior. While the group-average contingency caused a decrease in the verbal negatives directed to the self, they were totally suppressed during the group-individual contingency. The group-average contingency produced a slight increase in negatives directed to the group. However, the group-individual phase produced a dramatic increase in negatives directed to the group.

While the results of this study are both interesting and informative their validity is somewhat questionable due to several major weaknesses in the study. The first weakness is that the effects of the contingencies on math performance are relatively inconclusive due to a ceiling effect. It was difficult to control for this effect and keep the math skills at an instructional level. It seems important that studies of this

type do not hinder the academic progress of the subjects by keeping the skill on the same level throughout the study. A more efficient method of controlling for a ceiling effect was needed in this study.

A second weakness is that only a three-phase experimental design was used. The study was originally designed to follow a five-phase reversal procedure. However, the length of time it took for math performance to stabilize in both the no-contingency and group-average phases made it impossible to re-institute the contingencies. Therefore, it is possible that the results were produced by the order of the presentation of the contingencies.

Despite these weaknesses we believe that the results indicate that group contingencies do produce "side effects." In this study it seems reasonable to conclude that the contingencies were at least partially responsible for the change in the verbal behavior of the group. The study adds support to the contention that it is necessary to consider the effects of a contingency on the total behavioral repertoire of a subject(s) and not just an isolated behavior. It is obvious that more and better research is necessary in this area so that the effectiveness and usefulness of behavior change techniques can be determined.

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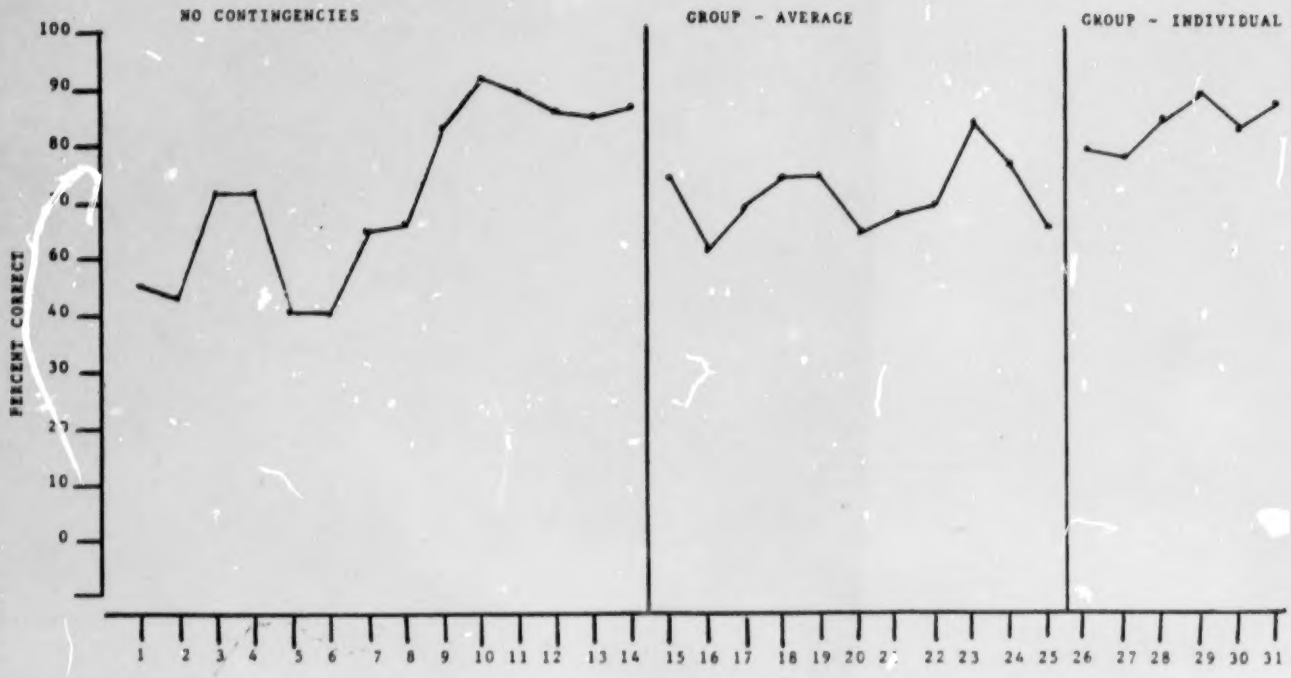

FIGURE 1

Average group math accuracy per session.

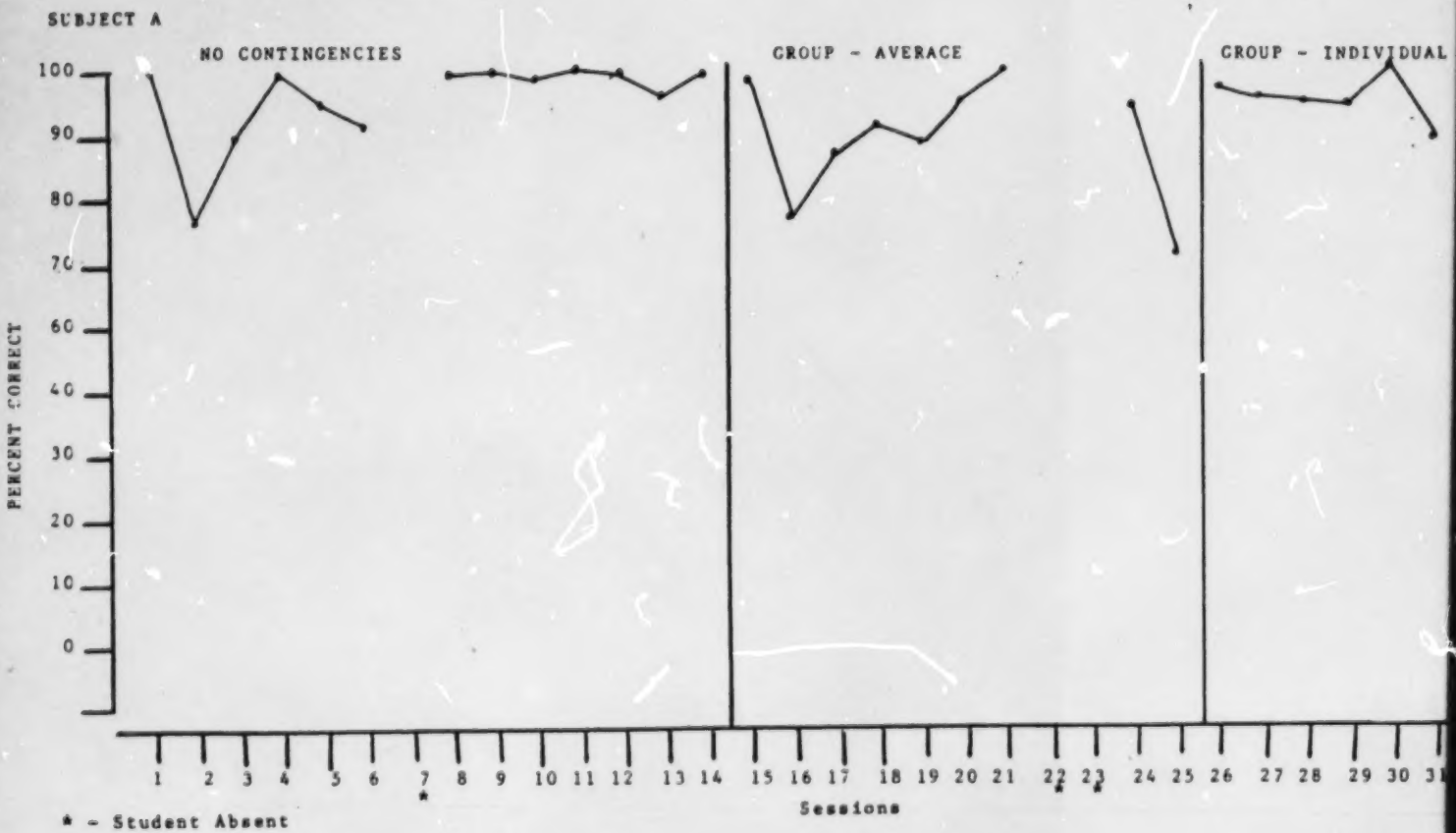

Figure 2a

Percent of math problems computed correctly per session for subjects A.

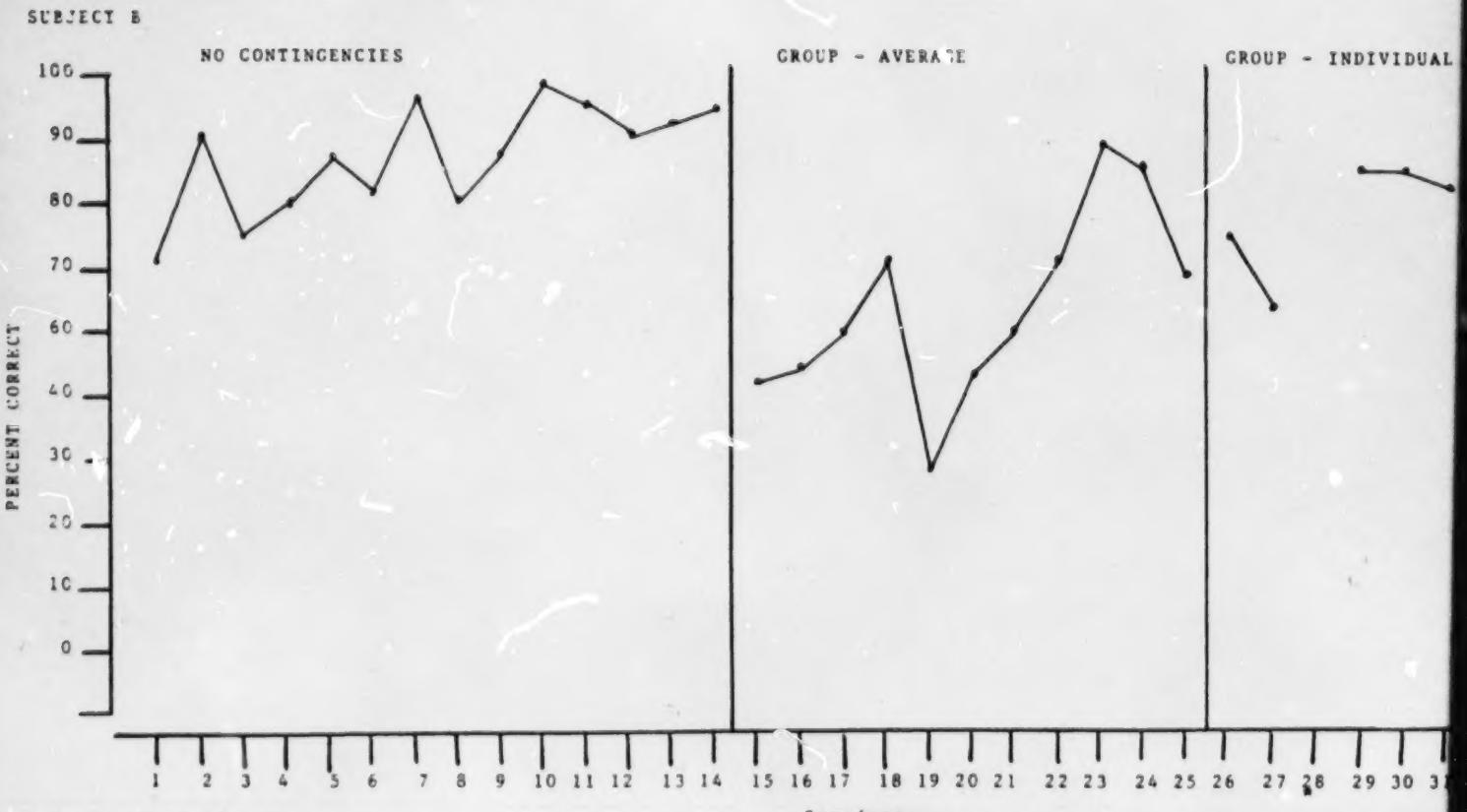

Figure 2b

Percent of math problems computed correctly per session for subjects B.

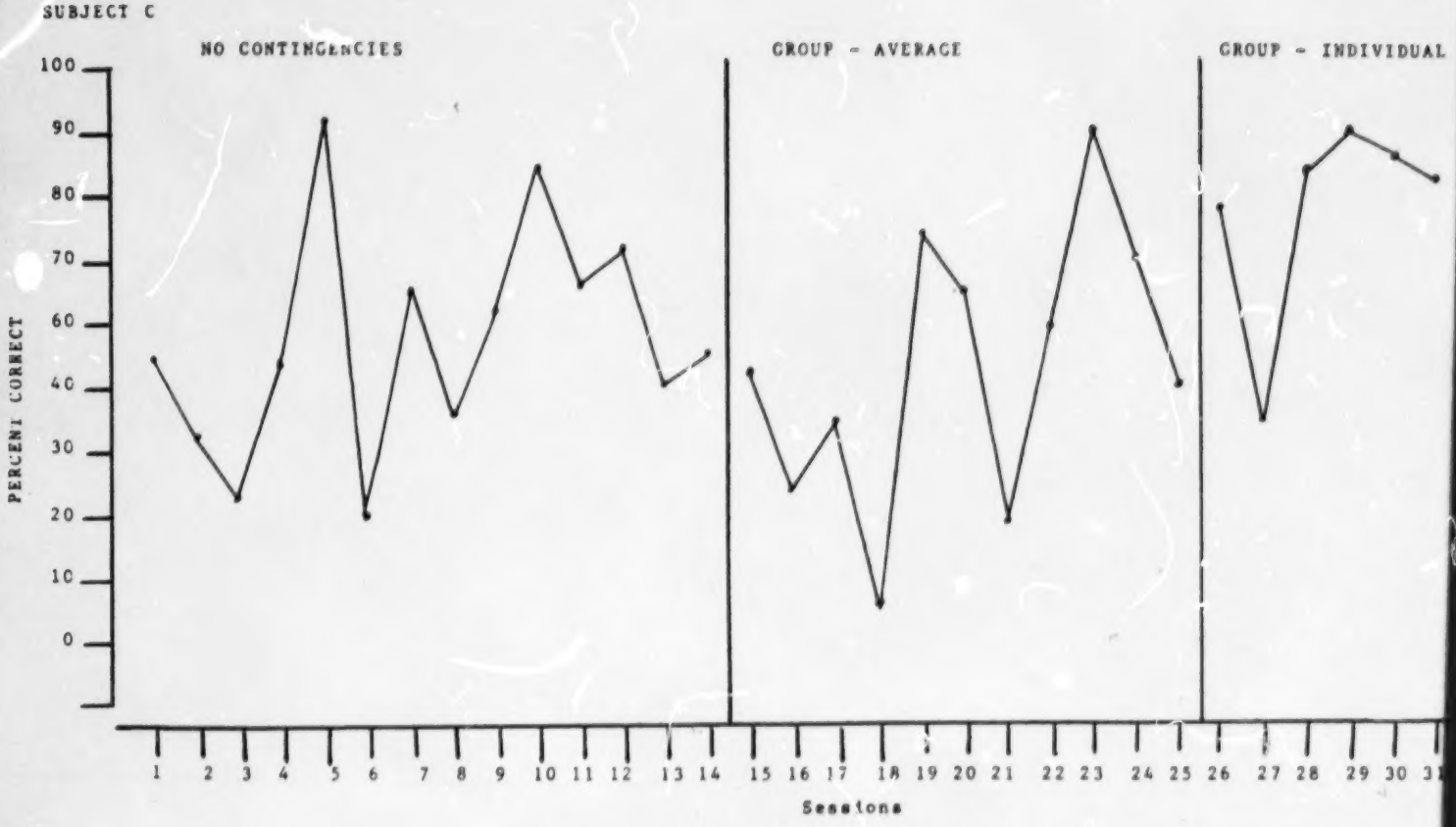

Figure 2c

Percent of math problems computed correctly per session for subjects C.

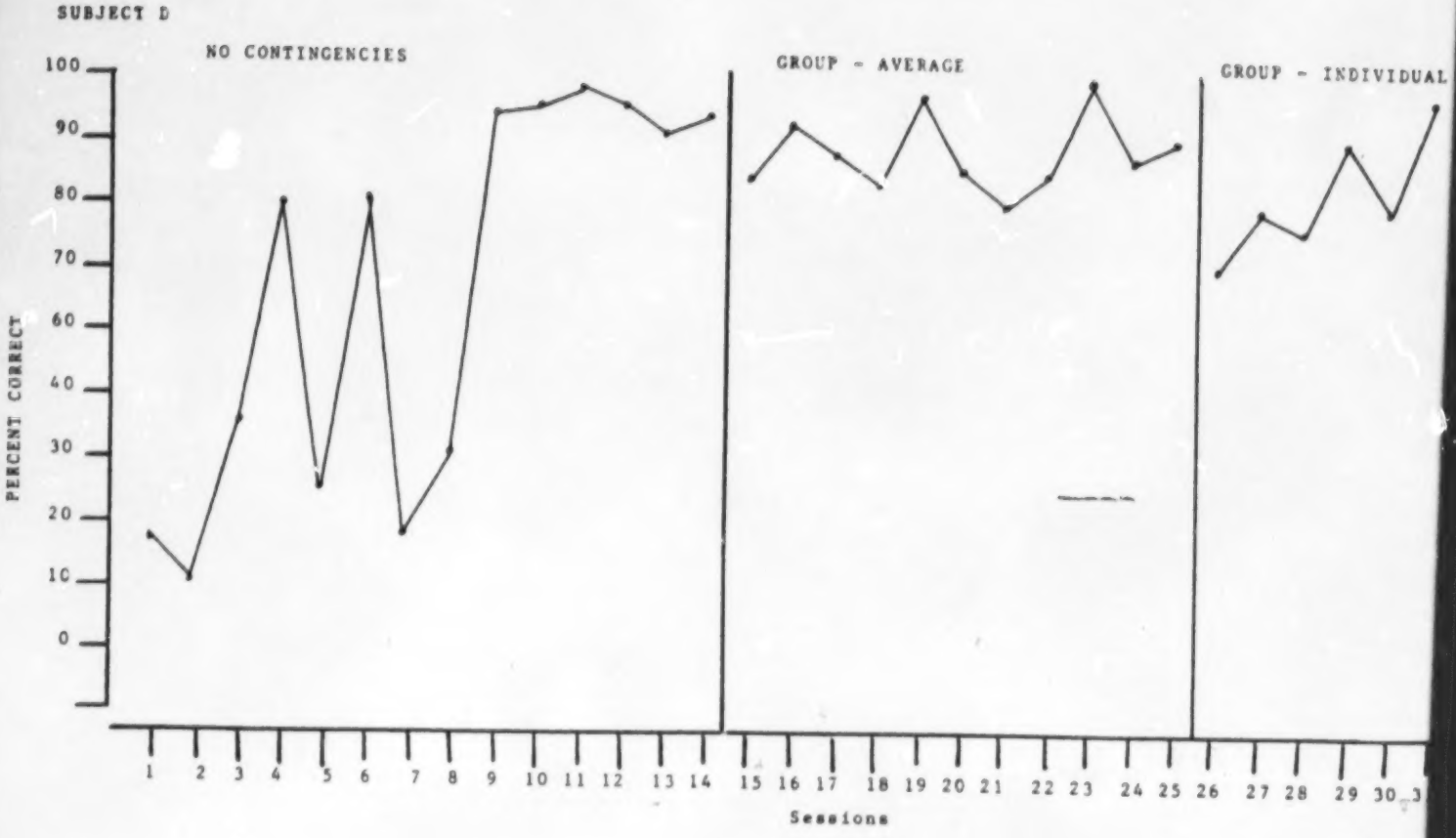

Figure 2d

Percent of math problems computed correctly per session for subjects D.

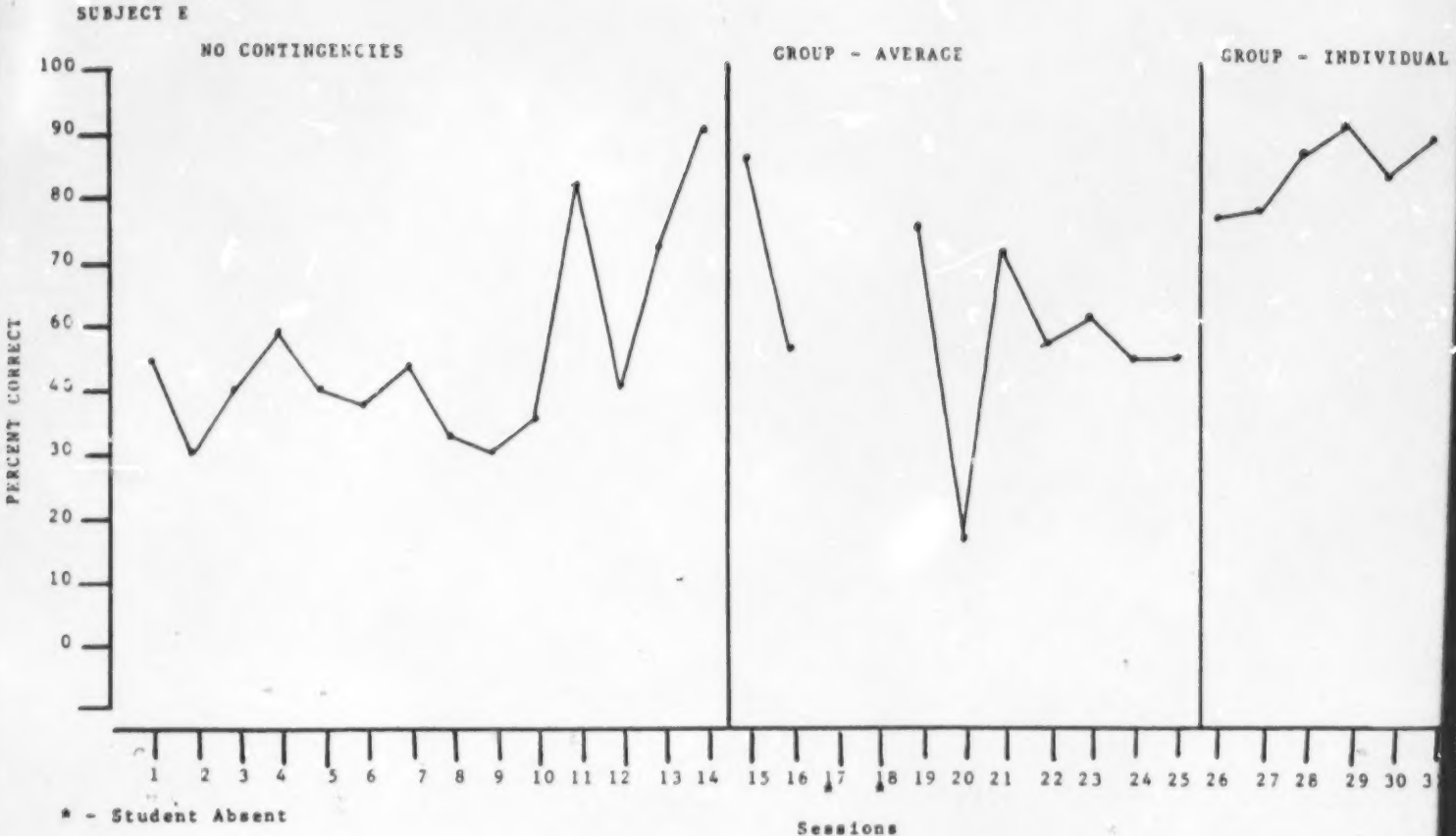

Figure 2e

Percent of math problems computed correctly per session for subjects E.

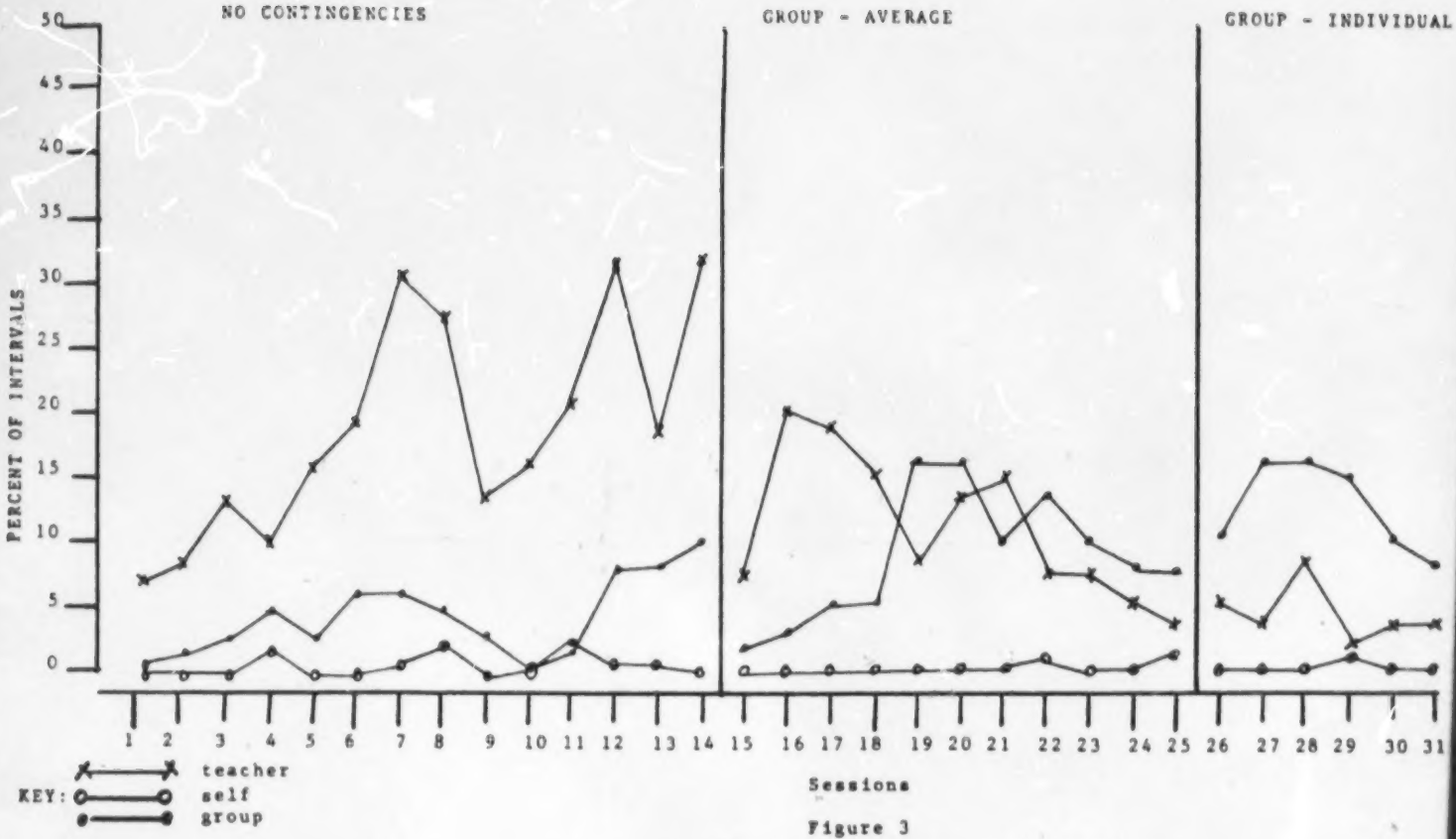

Figure 3

Percent of intervals verbal neutrals were directed to the teacher, self, and group per session.

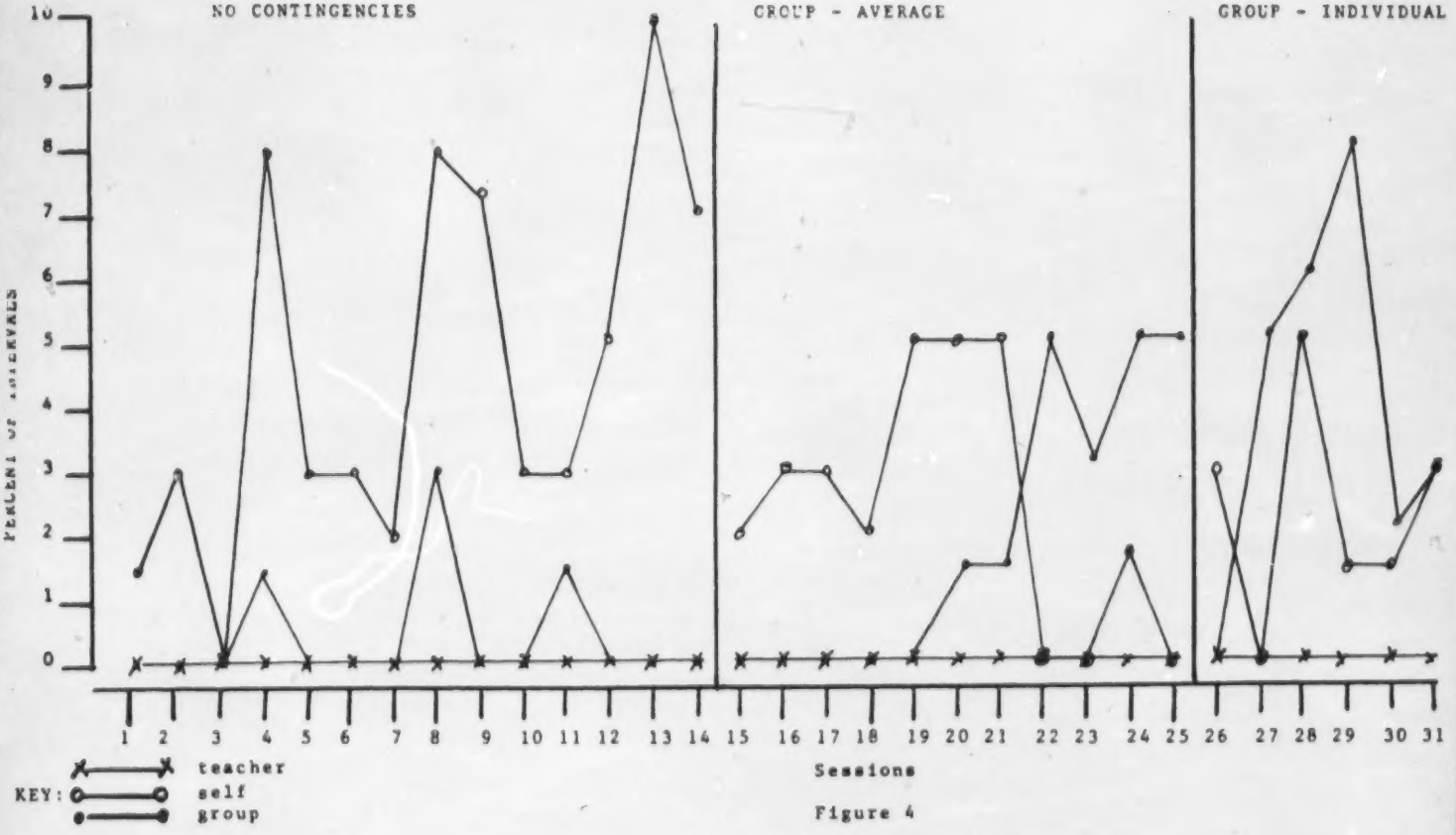

Figure 4

Percent of intervals verbal positives were directed to the teacher, group, and self per session.

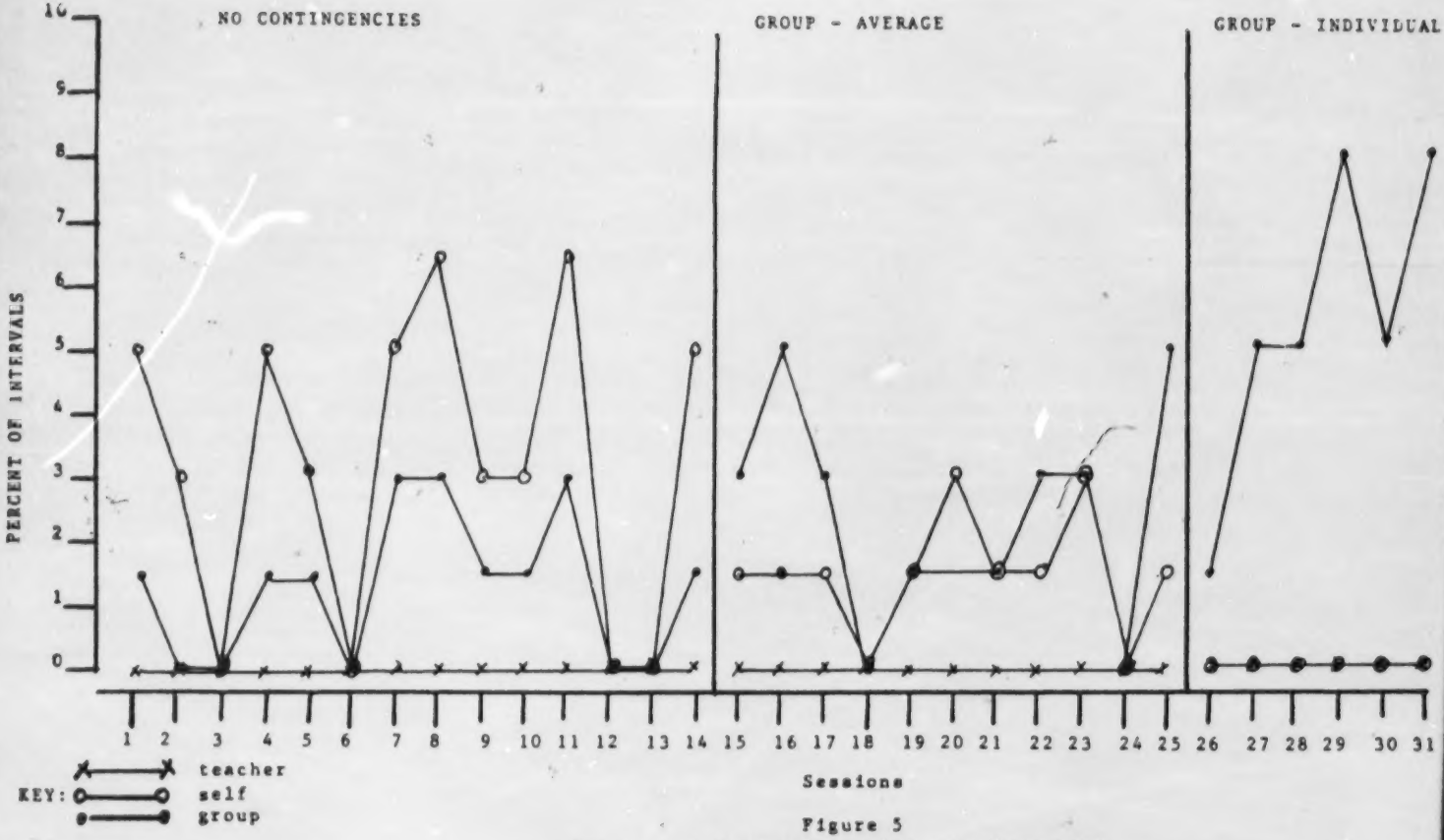

Figure 5
Percent of intervals verbal negatives were directed to the teacher, group, and self, per session.

V
N
V
P
V
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30